Claim Rejections – 35 USC §103

The examiner rejected claims 1-7, 11-18, and 22 under 35 USC §103(a) as unpatentable over Mortazavi et al. (5,838,515) in view of Duerbaum et al. (6,711,034) and further in view of Rowan (5,986,426). The applicant respectfully disagrees.

Regarding claim 1, the examiner asserts that Mortazavi discloses a disk drive comprising a voce coil motor (VCM) for actuating a head radially over a disk and a conventional PWM generator for driving an H-bridge driver to control operation of the VCM. The examiner concedes that Mortazavi does not disclose to generate the PWM signal so that during a Tforward interval of the PWM cycle a positive control voltage is applied to the voice coil, during a Treverse interval of the PWM cycle a negative control voltage is applied to the voice coil, and during a Tdead interval of the PWM cycle a substantially zero control voltage is applied to the voice coil. The examiner asserts that Mortazavi could be modified in view of Duerbaum and Rowan to arrive at the present invention. The applicant respectfully disagrees.

Duerbaum discloses a DC-DC converter and method of regulating the DC-DC converter using a PWM signal. However, DC-DC converters is a completely disparate field that has nothing to do with voice coil motors. One skilled in the art would not look to the field of DC-DC converters when designing a controller for a voice coil motor. Even assuming one skilled in the art would look to DC-DC converters, nothing in Duerbaum would disclose any benefit of modifying a PWM generator in the manner taught by the applicant. Duerbaum teaches to adjust the duty cycle of a PWM signal to compensate for asymmetry in the output voltage of a DC-DC converter (see Abstract). However, this motivation is not applicable to the control of voice coil motors, that is, one skilled in the art would not modify the PWM generator of a VCM controller to compensate for asymmetry. Since Duerbaum is completely disparate art from the field of

voice coil motors, and because nothing in Duerbaum discloses a motivation for the modification recited in the claims, the rejection should be withdrawn.

Still further, Duerbaum discloses a PWM signal comprising a Tforward and Treverse interval OR a Tforward and Tdead interval not a PWM signal comprising a Tforward, Tdead, AND a Treverse interval as recited in the claims. Referring to col. 4, lines 20-35, Duerbaum discloses that the PWM signal comprises a Tforward interval (positive voltage) and then a Treverse interval (negative voltage), OR a Tforward interval (positive voltage) and then a Tdead interval (zero voltage). In contrast, the claims recite a PWM signal comprising all three intervals: a Tforward (positive), a Treverse (negative), AND a Tdead (zero). The rejection should be withdrawn because the examiner's construction of Duerbaum is incorrect.

The examiner asserts that Rowan discloses to adjust the Tdead interval of a PWM cycle to control a magnitude of ripple current flowing through the voice coil. However, Rowan merely discloses to adjust the switching frequency of the PWM signal to adjust the ripple current (e.g., to reduce it) relative to a mode of operation. For example, increasing the switching frequency of the PWM signal to reduce the ripple current and improve efficiency (col. 3, lines 50-56). However, nothing in Rowan would suggest a benefit of driving the VCM with a PWM signal having a Tforward interval and a Treverse interval as recited in the claims. Further, nothing in Rowan suggest to control ripple current by adjusting a Tdead interval of the PWM signal. The rejection should be withdrawn.

Regarding claim 11, the examiner asserts that Duerbaum discloses to adjust the Tdead time interval for power to be utilized optimally. However, optimizing power in a DC-DC converter has nothing to do with maintaining a constant ratio of an effective inductance (L) to an actual resistance (R) in a voice coil motor. As disclosed on page 6, lines 5+, of applicant's specification:

> "Maintaining a constant ripple current is mathematically similar to holding the inductance L of the voice coil 34 constant regardless of circuit voltages resulting in predictable performance. In one embodiment, the ripple current is adjusted so that the inductance L tracks variations in the resistance R of the voice coil 34 due to temperature drift, thereby maintaining a substantially constant effective L/R time constant. In this manner the lag due to the L/R time constant can be canceled using well known analog and/or digital feedforward compensation (pole-zero cancellation). The feedforward compensation enables the use of lower gain circuits which reduces the total bandwidth requirement allowing lower speed and less expensive digital techniques to replace analog compensation loops. In addition, maintaining a substantially constant L/R time constant compensates for the time lag introduced by the PWM cycle time."

Nothing in Duerbaum would suggest any benefit for maintaining a substantially constant L/R time constant. The rejection should be withdrawn.

Regarding claim 2, Duerbaum does not disclose or suggest to ground the first and second ends of a voice coil during the Tdead interval.

Regarding claims 3 and 4, nothing in Duerbaum or Rowan discloses to compute a Tforward or Treverse interval in response to a target ripple current.

Regarding claim 5, Duerbaum does not disclose or suggest to compute the Tdead time interval in response to the Tforward and Treverse intervals.

Regarding claim 6, Duerbaum does not disclose or suggest to adjust the Tforward and Treverse intervals in response to a current command.

Regarding claim 7, nothing in Duerbaum or Rowan discloses to compute a Tdead interval in response to a target ripple current and a measured ripple current.

The rejections of the remaining claims should be withdrawn for the reasons set forth above.

CONCLUSION

In view of the foregoing remarks, the rejections should be withdrawn. In particular, Duerbaum is completely disparate art which discloses nothing about the control of voice control motors, let alone any benefit of modifying a PWM generator as recited in the claims. Although Rowan discloses techniques for controlling a VCM in a disk drive, nothing in Rowan or Duerbaum discloses or suggest to drive the VCM with a PWM signal having a Tforward interval, Treverse interval, and Tdead interval, or to adjust the Tdead interval in order to control the ripple current. The examiner is encouraged to contact the undersigned over the telephone in order to resolve any remaining issues that may prevent the immediate allowance of the present application.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on:

3/9/05 Howard H. Sheerin
(Date) (Print Name)

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